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NAS WHITING FIELD
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FINAL REPORT ON THE FINDINGS OF THE PETREX SOIL GAS SURVEYS PERFORMED AT NORTH FIELD SITES 3 AND 32, SOUTH FIELDS SITES 29 AND 30, AND THE MID FIELD SITES 5, 6, AND 33 NAS WHITING FIELD FL

9/4/1992

ABB ENVIRONMENTAL SERVICES, INC

(19)

F I N A L R E P O R T
ON THE FINDINGS OF THE PETREX SOIL GAS SURVEYS PERFORMED AT THE NORTH FIELD (SITES 3 AND 32) THE SOUTH FIELD (SITES 29 AND 30) AND THE MID FIELD (SITES 5, 6, AND 33) NAS-WHITTING FIELD IN MILTON, FLORIDA

CONDUCTED FOR:
ABB ENVIRONMENTAL SERVICES

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1.0 INTRODUCTION

In June, 1992, Northeast Research Institute, Inc. (NERI) was subcontracted by ABB Environmental Services, Inc. (ABB-ES) to conduct Petrex passive soil gas surveys at the North Field (Sites 3 and 32), South Field (Sites 29 and 30), and Mid Field (Sites 5, 6, and 33) located in Milton, Florida.

The primary purpose for conducting the surveys was to assist ABB-ES in the Remedial Investigation/Feasibility Study (RI/FS) of the North Field, South Field, and Mid Field survey areas by screening the subsurface environment for volatile and semivolatile organic compounds (VOCs and SVOCs).

Each of the survey areas, excluding Site 29, consisted primarily of aviation maintenance hanger buildings and surrounding air fields. Operations at each site included the repair and maintenance of aircraft and other vehicles. Site 29 is an auto hobby shop. Compounds of interest for each survey area included BTEX and other petroleum hydrocarbon mixtures, as well as chlorinated hydrocarbons commonly used to clean or degrease machinery.

Areas of concern at each site were limited primarily to former UST locations as well as to the transformer areas, barrel storage areas, wash rack areas, and paint booths surrounding the hanger buildings.

2.0 OBJECTIVES

The objectives of this survey were to:

1. Collect and report VOCs and SVOCs from the soil gas;

2. Map the areal extent of the detected compounds; and

3. Attempt to indicate source areas, plume boundaries, and migration/dispersion pathways of the reported VOCs through groundwater and soils.

2.1 Overview of the Petrex Technique

Each Petrex soil gas sampler consists of twin activated carbon adsorption elements housed in a resealable glass container in an inert atmosphere. The soil gas adsorption element is a metallic wire, having specific ferromagnetic characteristics, to the end of which is bonded a discrete amount of activated charcoal.

Soil gas sample collection is performed by unsealing the sampler and exposing the adsorption elements to the soil gas of the subsurface environment at the base of a shallow borehole. Sample collection proceeds via free vapor diffusion through the opening of the uncapped sampler container. Following a controlled period of time, the sampler is retrieved from the borehole, resealed, and submitted for analysis.

Analysis of each individual soil gas sample is performed via Thermal Desorption/Mass Spectrometry (TD-MS) and yields data in the form of a numerical file categorizing by atomic weight the relative abundance of chemical compounds collected by each sampler. This information is graphically represented as a mass spectrum. Data on a particular compound or class of compounds are further presented in reference to a sample number and sample collection point on a relative flux map.

3.0 SURVEY DESIGN

A total of 221 Petrex soil gas samplers were utilized at the North Field, South Field, and Mid Field survey areas of the NAS-Whiting Field. The survey designs were established by ABB-ES and actual sample numbers and locations are provided in Plates 1A, 2A, and 3A, Appendix B.

3.1 North Field Survey Area

A total of 106 Petrex soil gas samplers were utilized at the North Field survey area (Sites 3 and 32). These samplers were placed on approximately 50 and 100 foot centers surrounding the maintenance hanger buildings at Sites 3 and 32. At Site 32 the grid extended east of the North Field maintenance hanger to encompass the wash rack and parking areas. Towards the west, the survey extended approximately 100 feet onto the airfield area.

At Site 3, the grid extended approximately 200 feet south of the hanger building and encompassed the abandoned underground waste oil tank and surrounding well locations. The grid also surrounded the maintenance hanger building as well as the eastern parking area.

3.2 South Field Survey Area

A total of 71 Petrex soil gas samplers were utilized at the South Field survey area. This survey area consisted of two neighboring sites (the South Field hanger, Site 30, and the auto hobby shop, Site 29).

At Site 30, 56 samplers were placed on approximately 50 and 80 foot centers surrounding the hanger and south control tower building. This grid extended approximately 100 feet east onto the airfield and encompassed the western work rack and storage areas.

At Site 29, 11 samplers were placed on approximately 50 foot centers within the parking area, surrounded by Buildings 1401, 2945, and 2975. Four additional samplers were placed specifically at the used oil tank and barrel storage area.

3.3 Mid Field Survey Area

A total of 44 Petrex soil gas samplers were utilized at the Mid Field survey area. These samplers were placed at specific locations surrounding the hanger building as well as on approximately 100 foot spacings encompassing the southwest draining area.

Sampling density was increased surrounding the above ground waste oil tanks and south of the hanger building.

4.0 FIELD METHODS

4.1 Installation and Retrieval

From June 9 through June 12, 1992, NERI and ABB-ES personnel conducted the installation phase of the survey. Following an average two week exposure period, on June 25 and 26, 1992, NERI retrieved 216 of the 221 Petrex samplers. Samplers were not recovered from sample location 100 (North Field), sample locations 15, 31, and 40 (Mid Field), and sample locations 28 and 57 (South Field).

This survey exposure period was determined by NERI based on the results from the set of four time calibration samplers that were analyzed following a approximately 72 hour exposure period at the survey areas.

On June 27, 1992, the entire batch of samplers were shipped via overnight courier to NERI's analytical laboratory in Lakewood, Colorado. The shipment was received on June 29, 1992 and analysis was completed on July 2, 1992 (see Chain of Custody document in Appendix D).

ABB-ES personnel were advised by NERI and assisted NERI in the field methods associated with installation and retrieval of this Petrex soil gas survey.

For a complete discussion of installation and retrieval operations, as well as survey exposure determination, see Appendix A, Petrex Protocol.

4.2 Field QA/QC

Throughout the field operations of this survey, the QA/QC procedures outlined in the Petrex Protocol, Appendix A, were adhered to by NERI and the ABB-ES personnel that assisted NERI in the field. These procedures included routine handling, packaging, and Chain of Custody shipment as well as uniform sampler installation and retrieval operations.

4.2.1 Decontamination

Field QA/QC procedures for this survey also included field screening by ABB-ES personnel of each soil gas boring by means of a portable flame ionization detector (FID) prior to the installation of the Petrex samplers, as well as decontamination of borehole equipment (1 1/2" diameter by 18" length drill bit) between sample collection points.

Due to generally background to non-detect FID screening results, decontamination operations were limited to brushing away soil materials followed by a pressurized deionized water rinse.

4.2.2 Ambient Air Blanks

Due to an appreciable odor of exhaust fumes from nearby aircraft, one sampler each was dedicated to the North Field and Mid Field survey areas as ambient air blanks. Ambient air was collected at sample location 59 (sample number 117) of the North Field survey area and sample location 33 (sample number 351) of the Mid Field survey area.

Ambient air sampling consisted of exposing the dedicated samplers to the ambient environment at the aforementioned sample locations. The ambient air blank from sample location 59 at the North Field survey area was exposed for 3-4 seconds during installation operations and again for 60 seconds during retrieval operations.

The ambient air blank from sample location 33 at the Mid Field survey area was exposed for 3-4 seconds during installation operations only. During retrieval operations no aircraft were operating in the area thus ambient air was not sampled.

The ambient air sample exposure periods were determined as representative of the actual amount of time each of the survey samplers were potentially exposed to ambient air conditions.

The ambient air samplers were analyzed by TD-MS. The only identifiable compounds present were the normal atmospheric compounds such as carbon dioxide. The mass spectra are provided in Appendix C.

5.0 METHOD QA/QC

A complete description of the analytical method QA/QC procedures is provided in the Petrex Protocol, Appendix A.

6.0 SURVEY RESULTS

The 216 Petrex soil gas survey samplers from the North Field, South Field, and Mid Field survey areas were analyzed by NERI's standard Thermal Desorption-Mass Spectrometry (TD-MS) method. After review of the mass spectral data, response intensity levels of the compounds listed below were selected for mapping.

North Field Survey Area

Plate 1A: Sample Location and Number Map
Plate 1B: Benzene, Toluene, Ethyl Benzene/Xylenes (BTEX) Relative Flux Map
Plate 1C: Tetrachloroethene (PCE) Relative Flux Map
Plate 1D: Trichloroethene (TCE) Relative Flux Map
Plate 1E: Cycloalkanes/Naphthalenes Relative Flux Map

South Field Survey Area

Plate 2A: Sample Location and Number Map
Plate 2B: Benzene, Toluene, Ethyl Benzene/Xylenes (BTEX) Relative Flux Map
Plate 2C: Tetrachloroethene (PCE) Relative Flux Map
Plate 2D: Trichloroethene (TCE) Relative Flux Map
Plate 2E: Cycloalkanes/Naphthalenes Relative Flux Map

Mid Field Survey Area

Plate 3A: Sample Location and Number Map - Mid Field
Plate 3B: Benzene, Toluene, Ethyl Benzene/Xylenes (BTEX) Relative Flux Map
Plate 3C: Tetrachloroethene (PCE) Relative Flux Map
Plate 3D: Trichloroethene (TCE) Relative Flux Map
Plate 3E: Cycloalkanes/Naphthalenes Relative Flux Map

These plates are provided in Appendix B.

6.1 Reported Compounds and Mapping

In order to map the reported compounds, the ion counts of particular peaks, or masses, were extracted from the analytical data files of each sample and were plotted at the X-Y location of the sample. As shown in the exemplary mass spectra, Appendix C, each of the reported compounds will have multiple peaks. The peak or mass that is most representative of the reported compound, and not subject to interference from other compounds, was selected. Table 1 lists the reported compounds and the mass spectral peak(s) used to map the compounds.

TABLE 1
Reported Compound/Class and The Mass Spectral Peaks

Compound	Mass Spectral Peaks
Sum of Benzene, Toluene Ethyl Benzene/Xylenes	Sum of: 78,92,106
Tetrachloroethene	164
Trichloroethene	130
Cycloalkanes/Naphthalenes	Sum of: 70,112,126,128,140,142,154,156

7.0 MAP EVALUATIONS

The soil gas response levels discussed in the following sections have been contoured relative to the results of each survey area. The ion count values that have been reported represent qualitative soil gas flux values that were evaluated relative to the other detections.

Ion count values are the unit of measure assigned by the mass spectrometer to the relative intensities associated with each of the reported compounds and respective masses listed in Table 1 of Section 6.1. These relative intensity levels or response levels do not represent an actual concentration of the reported compounds; however, they are best utilized as a qualitative measure where a change in ion count values in orders of magnitude is considered significant for interpreting potential source areas and migration/dispersion pathways versus background areas.

For a complete discussion of relative flux map evaluation, please refer to the Petrex Protocol in Appendix A.

7.1 North Field Survey Area Map Evaluations

7.1.1 Benzene, Toluene, Ethyl Benzene/Xylenes (BTEX) Relative Flux Map

Plate 1B, Appendix B, was created by plotting the summed ion counts of BTEX. The overall distribution of the contoured areas suggests that these responses are likely due to localized dispersion in the soils. For instance, in the vicinity of the oil separator, Petrex samplers show an area of elevated response limited to samplers 33 and 34. The other contoured detections consist of one and two points scattered across the study area.

7.1.2 Tetrachloroethene (PCE) Relative Flux Map

The PCE map is provided in Appendix B as Plate 1C and shows the ion counts associated with the PCE indicator peak 164. The areas suggestive of potential soil sources of PCE are contoured at the northeast and southwest corners of the Maintenance Hanger and around the UST.

Two other single points are contoured as elevated responses at locations 74 and 104.

7.1.3 Trichloroethene (TCE) Relative Flux Map

The TCE indicator peak used to produce Plate 1D, Appendix B, was mass 130. Plate 1D shows the potential for TCE presence on the north and south sides of the Maintenance Hanger.

7.1.4 Cycloalkanes/Naphthalenes Relative Flux Map

The cycloalkanes and naphthalenes responses were summed to represent the potential presence of refined petroleum products other than aromatic hydrocarbons. Examples of other petroleum products that may be represented on Plate 1E, Appendix B, are diesels, heating oils, and motor oils. It should be noted that since this is a general hydrocarbon indicator map, the possibility exists that paved areas may contribute to the soil gas signal. This may be the case at some of the points shown in parking lots. However, the area bounded by samplers 19, 22, 24, 25, 26, 27, 28, 32, 33, and 34 in the vicinity of the oil separator and UST suggests an area which may require further sampling.

7.2 South Field Survey Area Map Evaluations

7.2.1 Benzene, Toluene, Ethyl Benzene/Xylenes (BTEX) Relative Flux Map

Plate 2B, Appendix B, suggests that there may be a potential release from the waste oil tank to the west of the South Control Tower. As well, there is an area of elevated response shown to the north of the South Control Tower. The other detections may be related to paved areas or very small localized incidents.

7.2.2 Tetrachloroethene (PCE) Relative Flux Map

Plate 2C, Appendix B, shows PCE detections at moderately elevated levels on the east and west sides of the South Control Tower. In addition, an east-west band of PCE detections are shown across the parking lot between Building 1404 and 2975. Paved areas do not normally contribute to PCE detections.

7.2.3 Trichloroethene (TCE) Relative Flux Map

The responses contoured on Plate 2D, Appendix B, suggest that the most serious problem around the South Control Tower is associated with TCE. This map shows relatively elevated responses on both the east and west sides of the Tower, with the contours broken to indicate the potential presence of TCE beneath the Tower.

7.2.4 Cycloalkanes/Naphthalenes Relative Flux Map

The elevated areas of Plate 2E, Appendix B, around the waste oil tank and the north side of the South Control Tower mimic the contours shown on Plate 2B.

The other contoured areas should be reviewed by others familiar with the site to provide an assessment of the potential sources of these soil gas responses.

7.3 South Field Survey Area Map Evaluations

7.3.1 Benzene, Toluene, Ethyl Benzene/Xylenes (BTEX) Relative Flux Map

The most significant contoured area of elevated response for BTEX on Plate 3B, Appendix B, is shown on the east side of the Hanger. Two other single points are contoured at locations 13 and 28.

7.3.2 Tetrachloroethene (PCE) Relative Flux Map

Plate 3, Appendix B, shows moderately elevated PCE detections on the west, south, and east sides of the Hanger as well as at location 28.

7.3.3 Trichloroethene (TCE) Relative Flux Map

The contoured areas of elevated TCE response shown on Plate 3D, Appendix B, suggest the potential for an extensive release around the west, north, and east sides of the Hanger.

7.3.4 Cycloalkanes/Naphthalenes Relative Flux Map

Plate 3E, Appendix B, shows the presence of the cycloalkanes/naphthalenes series as a contoured area on the east side of the Hanger. There are three single point detections at locations 13, 28, and 38.

8.0 CONCLUSIONS

The results of this Petrex soil gas survey at NAS-Whiting Field suggest the following conclusions:

1. The most prominently detected chlorinated compounds were PCE and TCE. The limited horizontal distribution of these compounds suggests that they are likely to be present principally as soil contaminants.

   The likely source areas for these compounds are maintenance, cleaning, and repair operations. More definition of exact source areas may be gained by continuing the soil gas survey through the slabs of buildings where detections have been noted around such buildings.

2. The petroleum based compounds such as BTEX and the cycloalkanes/ naphthalenes are likely derived from sources such as gasoline, aviation fuels, diesel, and other oils. The possibility exists that paved areas, and their associated oil and gasoline staining, may be contributed to some of the detections contoured in parking lots.

APPENDIX A

PETREX PROTOCOL

REVISED AUGUST 1992

PETREX ENVIRONMENTAL SOIL GAS PROTOCOL

INTRODUCTION

The Petrex Technique provides a means by which trace quantities of gases from subsurface derived organic contaminants can be detected and collected at the earth's surface. The Technique is integrative, thereby eliminating the short-term variations associated with other gas/vapor detection methods. The Petrex Technique directly collects and records a broad range of organic compounds emanating from subsurface sources.

SOIL GAS COLLECTOR PREPARATION

Adsorption collector wires (after construction) are cleaned by heating to 358°C in a high vacuum system.

Wires are packed under an inert atmosphere in glass culture tubes.

One collector out of every batch of thirty is checked for cleanliness by mass spectrometry. Another collector from the batch is checked for adsorptive capability. Based on the results, the batch of collectors is approved for release into the field.

SOIL GAS SAMPLER INSTALLATION

The sampler consists of two collectors, each a ferromagnetic wire coated with an activated carbon adsorbent in a screw top glass culture tube. Each sampler is typically placed in a shallow hole, 14-18 inches deep. The hole is backfilled and the location is marked. The sampler is left in the ground from one to thirty days, then retrieved and sealed for transportation back to the laboratory for analysis.

The Petrex soil gas sampling technique is adaptable to various surface conditions commonly encountered within survey areas. These surfaces typically include concrete, asphalt, grass, and gravel. Two installation methods are routinely utilized to adapt to these surface conditions.

The first method utilizes a coring shovel for sampler installations in grass or otherwise loosely consolidated soil conditions. The shovel cores a 14 inch deep by 2 inch diameter hole in the surface soils.

Petrex soil gas samplers are placed (open end down) at the bottom of each core hole. The samplers are then backfilled with an aluminum foil plug and the original excavated soil. To complete installation, sample locations are marked with ribbon flagging and a numbered pin flag, as well as entered into a field notebook and plotted on a field map.

The second method of sampler installation utilizes an electric rotary hammer, equipped with an 18 inch by 1.5 inch diameter drill bit, for sampler installations under concrete, asphalt, or otherwise consolidated conditions. A hole is drilled through the surface to the dimensions of the drill bit equipped to the rotary hammer.

Petrex soil gas samplers are placed at the bottom of each drilled hole. For retrieval purposes, a cleaned galvanized steel wire is attached to each sampler. Aluminum foil is used to plug each hole to approximately two inches below grade. Then each hole is capped to grade with hydraulic cement. The hydraulic cement serves as protection from the external surface environment.

To complete sampler installation, sampler locations are marked with paint (where applicable), entered into a field notebook, and plotted on a field map.

SOIL GAS SAMPLER RETRIEVAL

Petrex soil gas samplers are retrieved following a time period that has allowed for the soil gas emanating from the subsurface environment of a survey area to equilibrate with the installed Petrex samplers. This time integration period is determined for each Petrex soil gas survey based on time calibration data or site conditions.

Retrieval operations are dependent on surface conditions and routinely consist of the following two methods.

The first method applies to grass covered or loosely consolidated soil conditions. A trowel is utilized to expose the backfilled samplers; then with a pair of tongs, the samplers are brought to the surface. At the surface, the samplers are sealed, cleaned, and labeled. Following retrieval, all debris are gathered and the core hole is backfilled with original material.

The second method applies to concrete, asphalt, or other consolidated surface conditions. A hammer and chisel is utilized to remove the hydraulic cement plug and expose the sampler. By means of the pre-attached retrieval wire, the sampler is brought to the surface. At the surface, the retrieval wire is removed and the sampler is sealed, cleaned, and labeled.

Following retrieval, each drill hole is backfilled and patched with cement or asphalt.

TIME CALIBRATION SAMPLERS

Time calibration samplers are included in Petrex soil gas surveys, as appropriate. These samplers are included as a means of monitoring the loading rates of volatile and semivolatile organic compounds (VOCs and SVOCs) emanating from the soil gas at a survey area onto the Petrex collectors.

During Petrex sampler installation, two sets of three to five time calibration samplers are also installed at survey sample locations that best represent the range of soil gas response for the survey area. These representative locations are determined based on previous soils and/or groundwater studies and other site specific conditions such as gradient and potential source areas.

The first set of time calibration samplers are generally retrieved within a week or less following the initial installation and the second set one week later. Often, permanent on-site personnel are instructed by NERI to perform time calibration sampler retrieval.

Lengths of exposure periods of the survey samplers for each survey are determined based on the results of each respective set of time calibration samplers. Time calibration samplers are usually analyzed within 24 hours upon receipt at the laboratory. At the first indication of significant relative ion count intensities and significant total ion count values, the decision is made by NERI to retrieve the entire complement of survey samplers.

If there are no significant relative ion count intensities detected from the second set of time calibration samplers, then the survey samplers are allowed to equilibrate in the field for a maximum time period of up to 30 days. The average environmental Petrex soil gas survey requires a collector integration period of one day to two weeks.

METHOD QA/QC

Approximately ten percent of the total Petrex survey samplers contain three collector wires. The first collector wire, a QC collector wire, is used by the operator to test the mass spectrometer's operating conditions prior to survey analysis. Some of these quality control (QC) collectors are also used to check the mass spectrometer sensitivity during survey analysis. In addition, the QC collector may be used to compare the reproducibility of the detected VOCs. Within every survey sampler, two or more collector wires should have adsorbed identical compounds. Like compounds on separate collectors relate an acceptable quality assurance (QA) during the survey's analysis. The second wire is analyzed by Thermal Desorption/Mass Spectrometry (TD/MS). The data from the second wire is reported on the relative flux maps. The third wire is retained for analysis by Thermal Desorption-Gas Chromatography/Mass Spectrometry (TD-GC/MS), if warranted by the initial TD/MS analysis of the second wire.

TRAVEL BLANKS

Two Petrex samplers, each containing a single collector wire, are included with each Petrex soil gas survey as travel blanks. These blanks are analyzed with the survey samplers to indicate whether there may have been contamination introduced to the survey samplers during installation or shipment. If compounds other than normal atmospherics (e.g., CO_2, H_20, N_2, and Ar) are detected on the blanks, then blank subtraction may be performed on the survey's data set. This process, an initial step to data interpretation, involves the correction of ion flux values of the detected blank contaminants from the entire survey's data set. The resulting ion flux values are provided on the relative flux maps.

MASS SPECTROMETER TUNING

An Extranuclear Quadrupole Mass Spectrometer or similar instrument, equipped with a Curie-point pyrolysis/thermal desorption inlet, is used for collector analysis. Mass assignment and resolution are manually adjusted using a Perfluorotributylamine (PFTBA) standard or a built-in tuning program, depending on the instrument. A linear correction, based on the known spectrum of PFTBA, is calculated. This correction is applied to a second PFTBA spectrum. If correct mass (M/Z) values are obtained, the operator proceeds to the next tuning step. If not, Step 1 is repeated until correct masses are obtained.

Peak intensity ratios are set from the major peaks in the PFTBA spectrum using the following values:

Mass (M/Z)		Spectrum Intensities
69	=	100%
131	=	48% ± 5%
219	=	50% ± 5%

During tuning, the ion signal for mass (M/Z) 69 of PFTBA is measured at a preset sample pressure and detector voltage and compared to previous values at the same setting.

Electron energy is set to 70 electron volts. All other operating parameters, such as scans, scan range, and mass offset, are established in the computer program. These values may only be changed by the laboratory manager.

Tuning is performed at the beginning of a run so that an individual survey is analyzed at the same set of instrument conditions. The samplers are analyzed in random order.

LABORATORY ANALYSIS

Periodic machine background and blank Petrex collector analyses are performed to assure that there is no carry-over between successive samplers. If there are peaks present which are not related to atmospheric gases, the supervisor is notified and the mass spectrometer is shut down and cleaned as necessary.

A written sample number record is kept during the analysis to prevent accidental cross numbering.

The mass spectrometer control program contains appropriate "flag statements" that prompt the operator with a warning if an input sample number has already been analyzed. The operator then checks the current number, along with the disk storage location of the previously entered number to identify the true numbering situation.

COMPOUND IDENTIFICATION

Compound identification is based on molecular weight, compound fragmentation, and isotope distribution, as applicable. Each VOC exhibits a unique mass spectral signature. NERI maintains a large library of spectra of individual compounds, accessible by computer. In addition, the company maintains a large library of mass spectra of commonly used chemical mixtures; e.g., gasolines, diesels, industrial oils and solvents, coatings, plastics, etc. These are used to assist in both compound and mixture identifications.

The ion count response of an indicator peak(s), representative of the compound and away from interference by other compounds, is extracted for data presentation and mapping.

INTERPRETATION OF SOIL GAS DATA

Soil gas data (including Petrex) reflect volatile and semivolatile organics collected at a point in the near surface. The sources of these volatile organics may be in the stratigraphic column and/or in groundwater below the collection point. Thus, the organics can be derived from surface spills, deposition, or migration into the deeper vadose zone, and groundwater. The soil gas survey reveals the areal extent of contamination and is the optimum guide in identifying areas in order to develop a vertical profile, including the drilling of soil borings and monitoring wells.

Soil gas data are always semi-quantitative in that multiple sources in soil and/or groundwater cannot be differentiated. However, the higher ion responses are representative of higher concentrations in the subsurface, given that geologic conditions are relatively consistent.

Due to chemical differences between individual compounds, including their ability to both adsorb and desorb from the charcoal Petrex collector element, it is invalid to compare the compound ion count at one sampling location to that of another compound.

Patterns of compound distribution in the soil gas, as detected at the surface, can be strongly influenced by irregularities in the near surface and subsurface environment through which the soil gas diffuses. These irregularities include subsurface man-made structures, such as concrete foundations, drainage systems, and wells, and such naturally occurring structures as fractured and unfractured bedrock, clay, and shale lenses.

Other factors influencing the soil gas signal include ground and surface water, the free carbon content of soils, microbiotic activity in the soil, and natural and synthetic ground cover.

All of these factors indicate that the most powerful use of soil gas data is in reconnaissance; identifying and mapping the relative abundance of the widest array of chemical species and mixtures. Efforts to relate soil gas response directly to groundwater or soil contaminant concentrations is generally not regarded as productive owing to the assumptions that are required for heterogeneity and source distribution.

RELATIVE RESPONSE DETERMINATION AND MAPPING

The relative response values are reported as the ion counts of indicator peaks for any given compound or mixture. Sample locations on a base map are digitized as X-Y coordinates and ion counts for the reported compounds are plotted at respective locations.

Mapping of the ion counts occurs after contour intervals for each compound or component class are determined. In order to establish the contour intervals, factors such as statistical analysis of ion count distribution, physiochemical considerations, and component-source material relationships (if known) are taken into account for each compound or class, in each area, on an individual basis. Each map is then contoured by hand. The resultant contour zones for each compound or component class in each area are color coded on a relative basis depending on whether the data are interpreted to be of high, moderate to high, moderate, etc., intensity. The response values found on each of the flux maps are color coded and contoured on this basis.

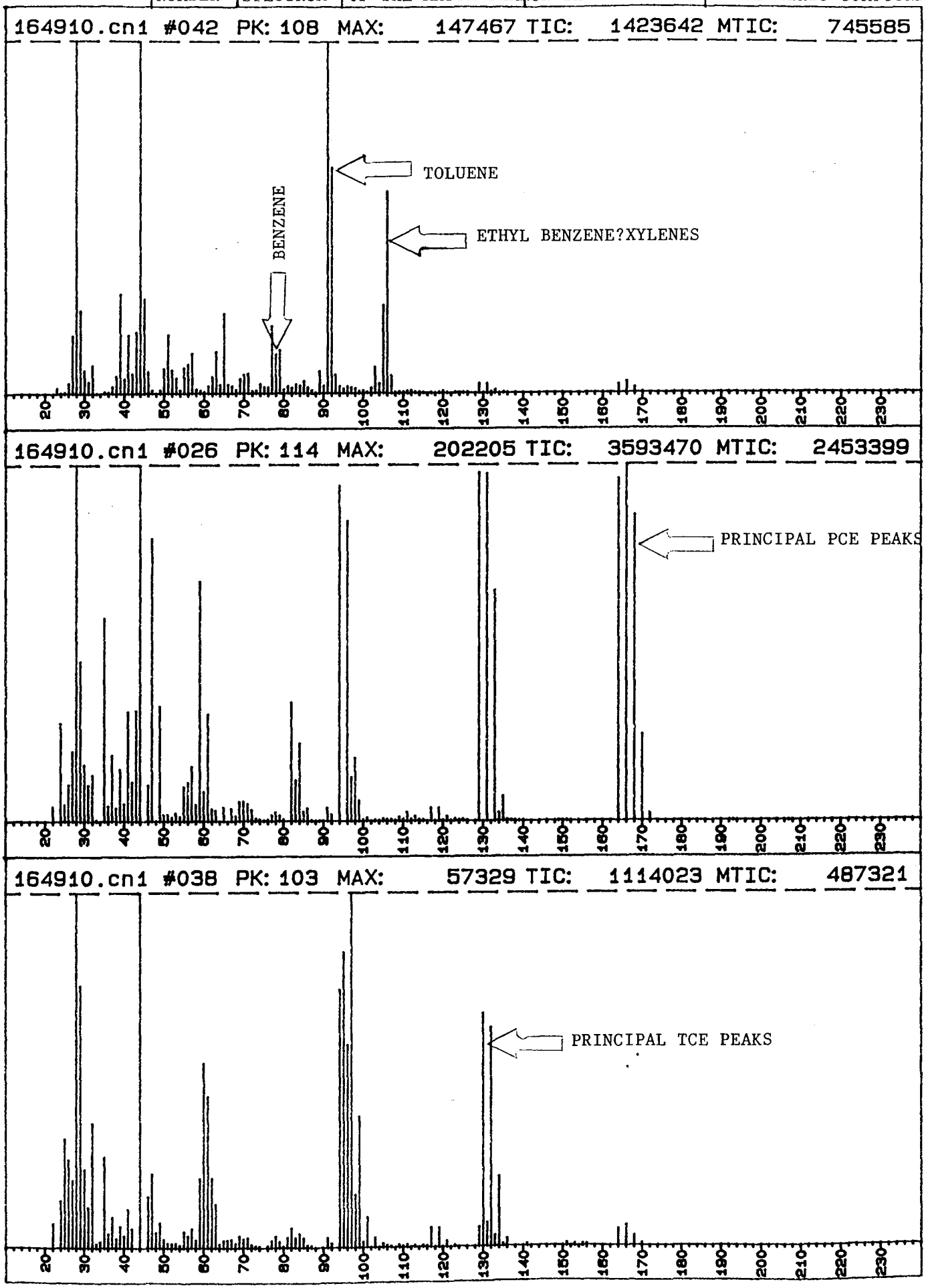
A P P E N D I X B

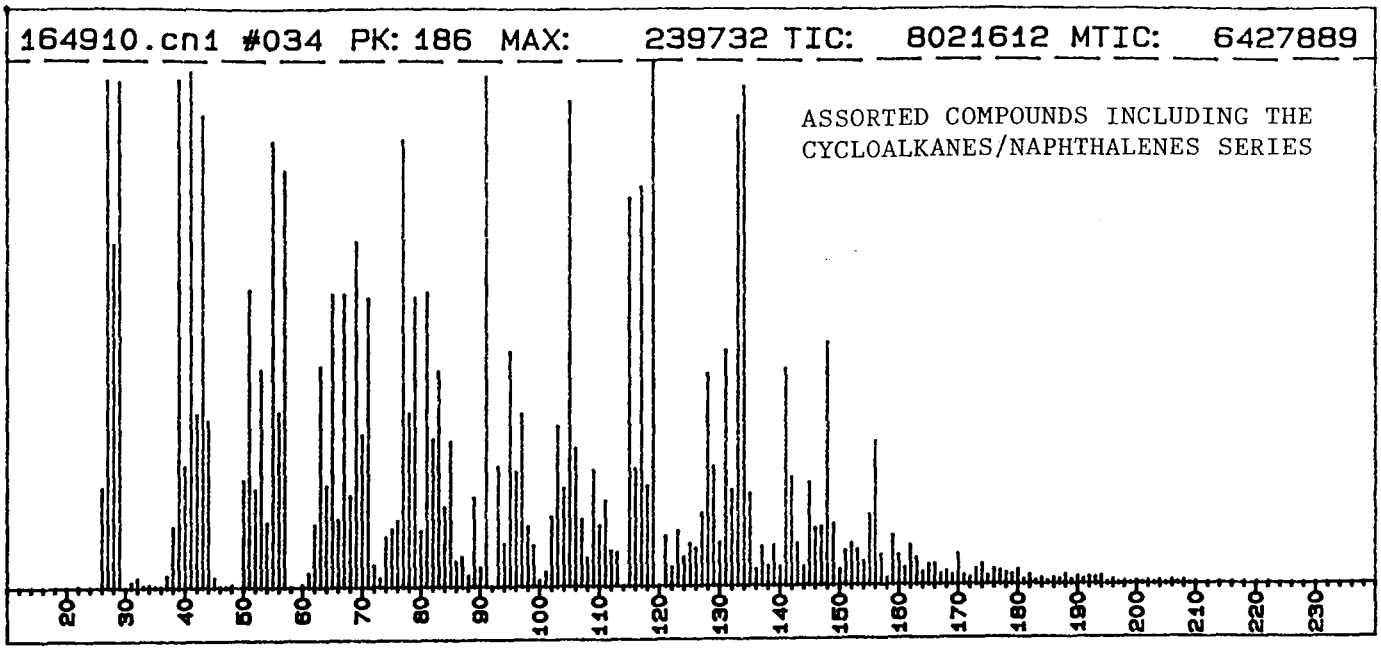
RELATIVE FLUX MAPS

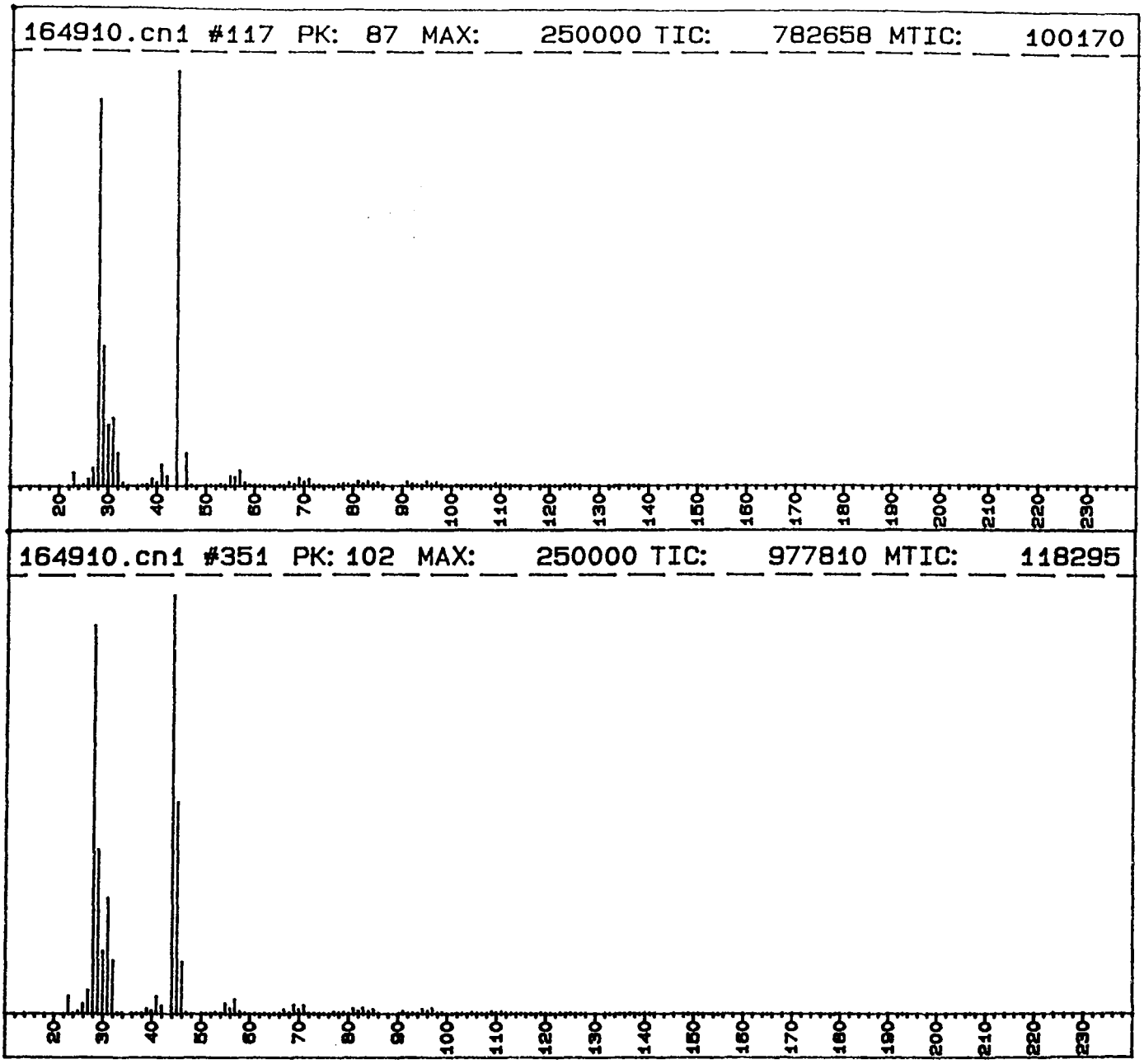
APPENDIX C

EXEMPLARY MASS SPECTRA

NERI JOB #	SAMPLE NUMBER	ON THE SPECTRUM	TOTAL ION COUNTS OF THE MAJOR PEAK	TOTAL ION COUNTS OF ALL THE PEAKS ON THE SPECTRUM	TOTAL ION COUNTS OF ALL THE PEAKS MINUS ATMOSPHERIC COMPOUNDS




164910.cn1 #034 PK: 186 MAX: 239732 TIC: 8021612 MTIC: 6427889
ASSORTED COMPOUNDS INCLUDING THE
CYCLOALKANES/NAPHTHALENES SERIES
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230



AMBIENT AIR EXPOSURE MASS SPECTRA

A P P E N D I X D

CHAIN OF CUSTODY FORM

Chain of Custody Document

Job Number 1649E (Please refer to this job number with all correspondence and shipments)

FIELD DATA:
Facility Whiting Field
Location Milton, Florida

Field Manager Salvatore Consalvi Phone 704/656/1293

CDD LAB DATA: GC/MS LAB DATA:

Instrument
Operator
Phone

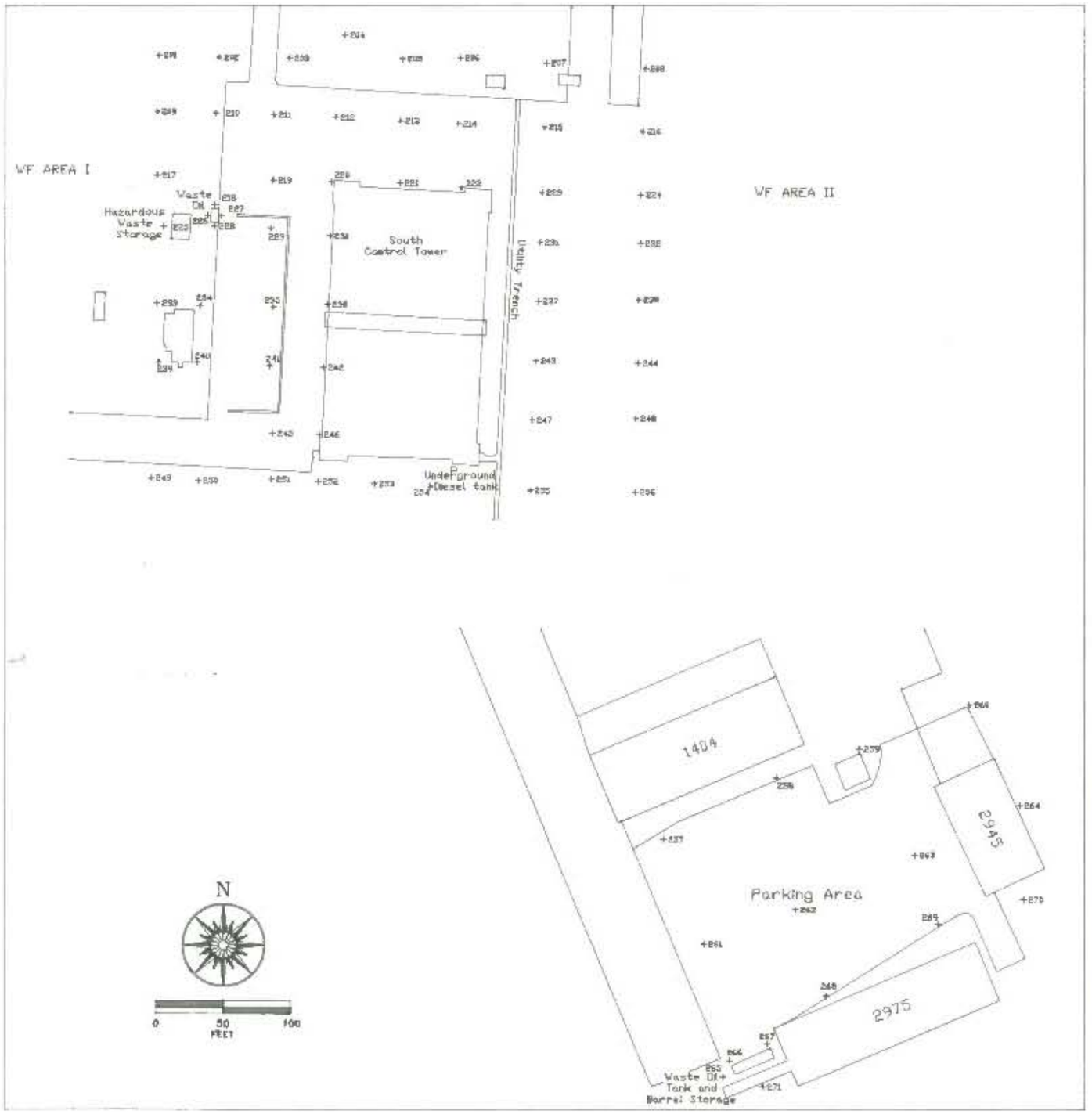
Sample Nos. 1-220 w/Time and Travel Bag #'s 7-9 of 993-BW/Bags #2-17 of 993BY

SAMPLE DATA:

Number of Samples 220 w/Time and Travel
Date Shipped to Field 6-5-92
Date Received in Field 6-6-92
Condition as Recd. in Field Good
Received By
Date Shipped from Field
Date Received from Field 6-29-92
Conditions as Recd. in Lab
Number Received 10/10-10, 20-69, 30-45 - 11 unused tubes & DSD book Maps
Received By KAW

SAMPLE TRANSFER DATA:

	Relinquished By:	Relinquished To:	Date:	Time:	Reason:
1.	NERI-East DJM	DJM	6-5-92	12:00	Survey/Shipment
2.	DJM	X. C. Goodwin	6-6-92	12:00	Inst. Shipment
3.	C. Goodwin	DJM	6-8-92	16:00	Install
4.	DJM	D.J.M. Fed Ex C-2591	~~6-22-92~~	13:00	Survey/Received
5.	DJM	Kelly Wambolt	6/29/92		LAB



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164920E

LEGEND

\+ Petrex Sample Location

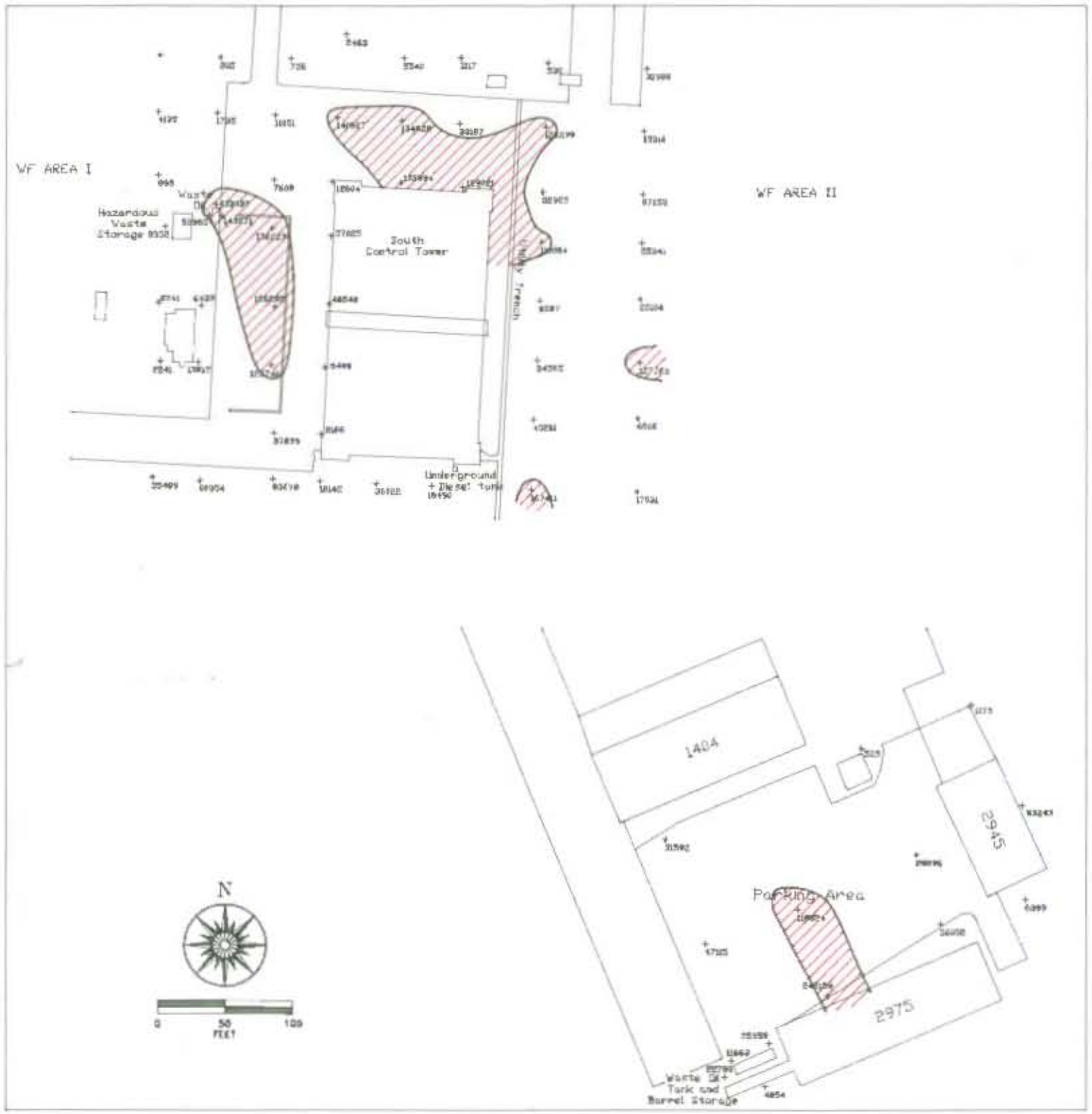
ABB Environmental Corp.

Sample Locations

NAS Whiting Field
South Field
Milton, Florida
Plate 2a

PETREX FINGERPRINT TECHNIQUE®

August 31, 1992



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LEGEND

Relative Response Values:

≥ 100,000

\+ Petrex Sample Location

ABB Environmental Corp.

Relative Response

Benzene, Toluene, Ethylbenzene & Xylenes (BTEX)

NAS Whiting Field

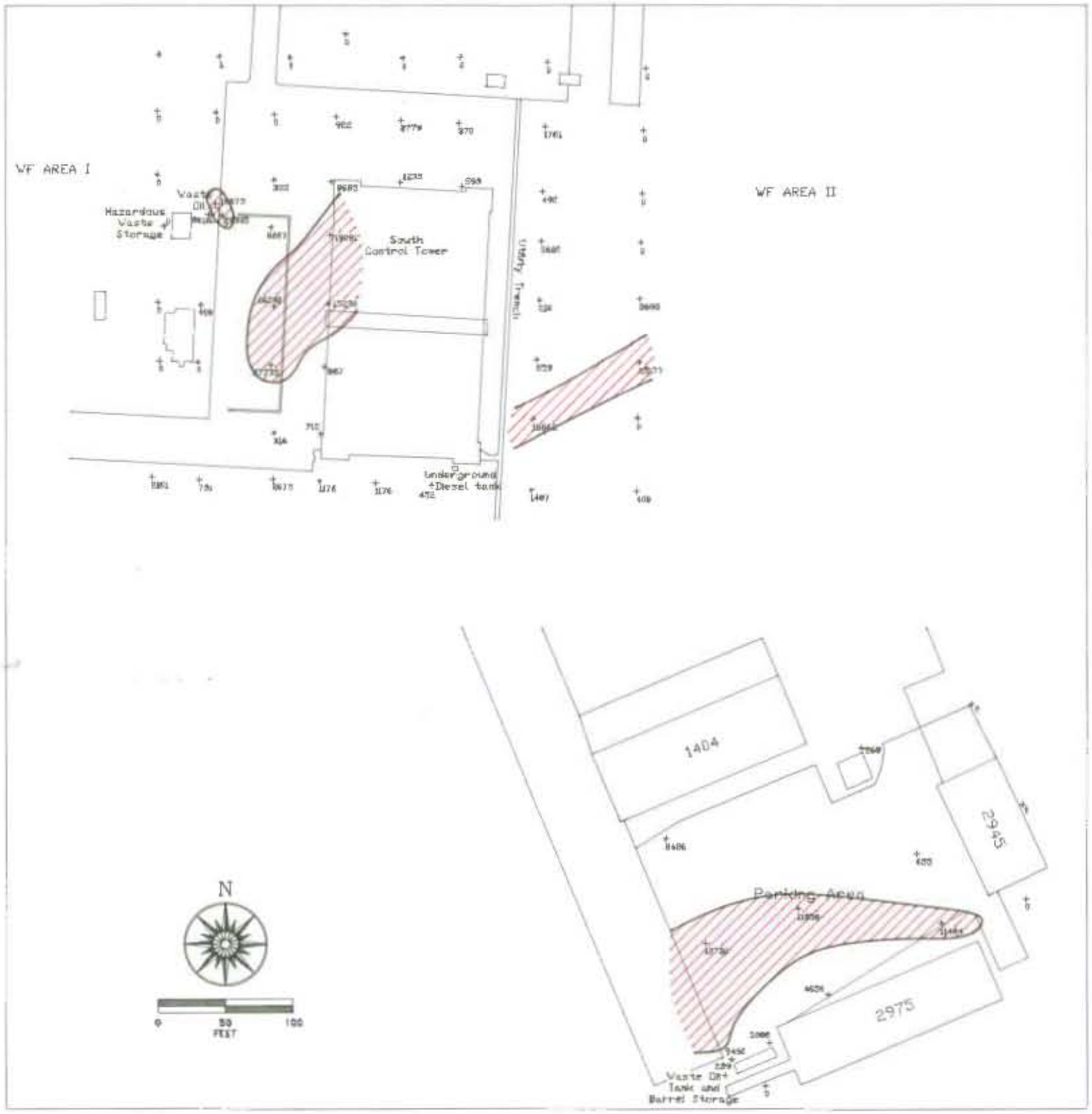
South Field

Milton, Florida

Plate 2b

PETREX FINGERPRINT TECHNIQUE®

August 31, 1992



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LEGEND

Relative Response Values:

≥ 10,000

\+ Petrex Sample Location

ABB Environmental Corp.

Relative Response

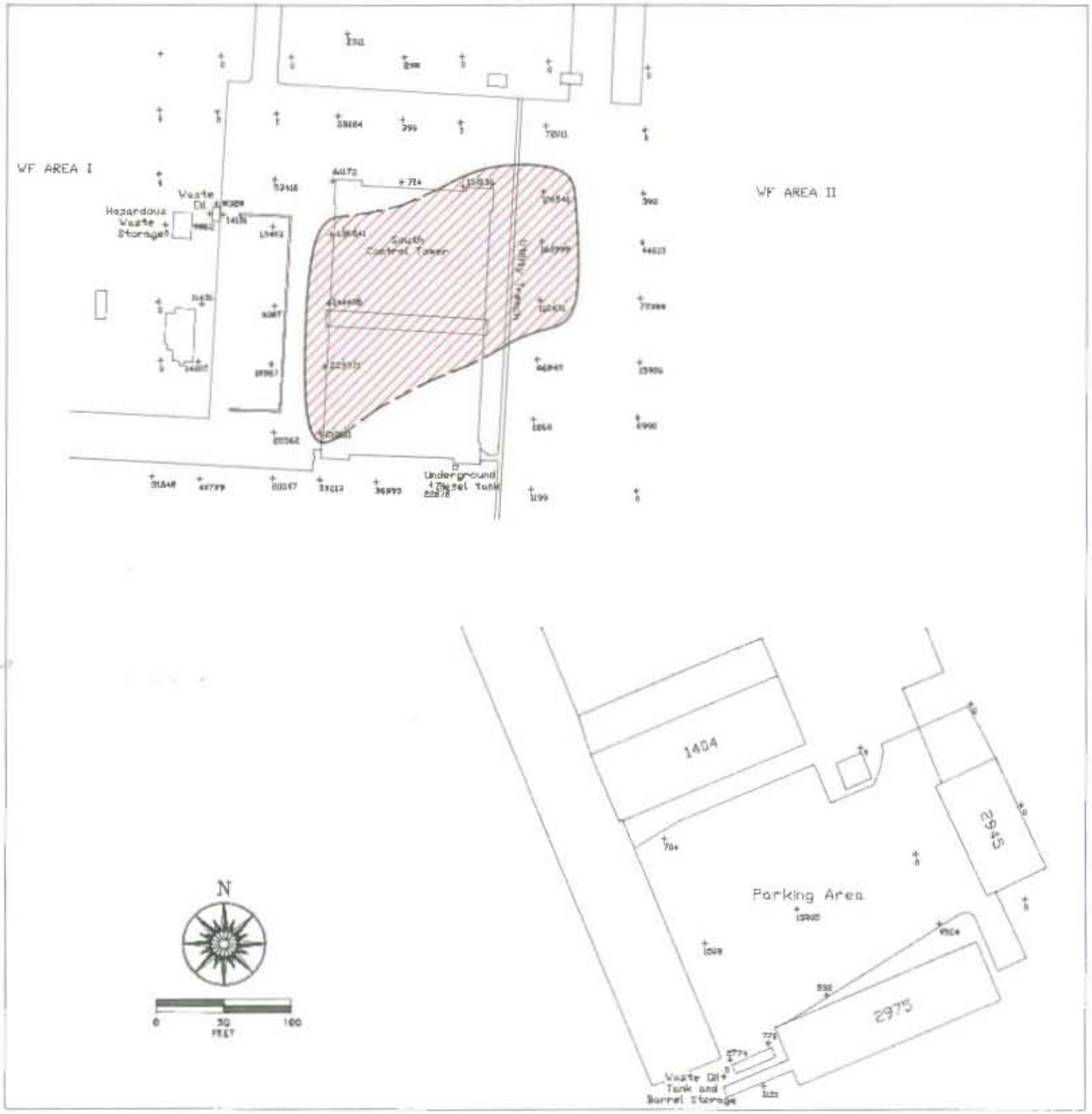
Tetrachloroethylene
(PCE)

NAS Whiting Field
South Field
Milton, Florida

Plate 2c

PETREX FINGERPRINT TECHNIQUE®

August 31, 1992



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LEGEND

Relative Response Values:

≥ 100,000

\+ Petrex Sample Location

ABB Environmental Corp.

Relative Response

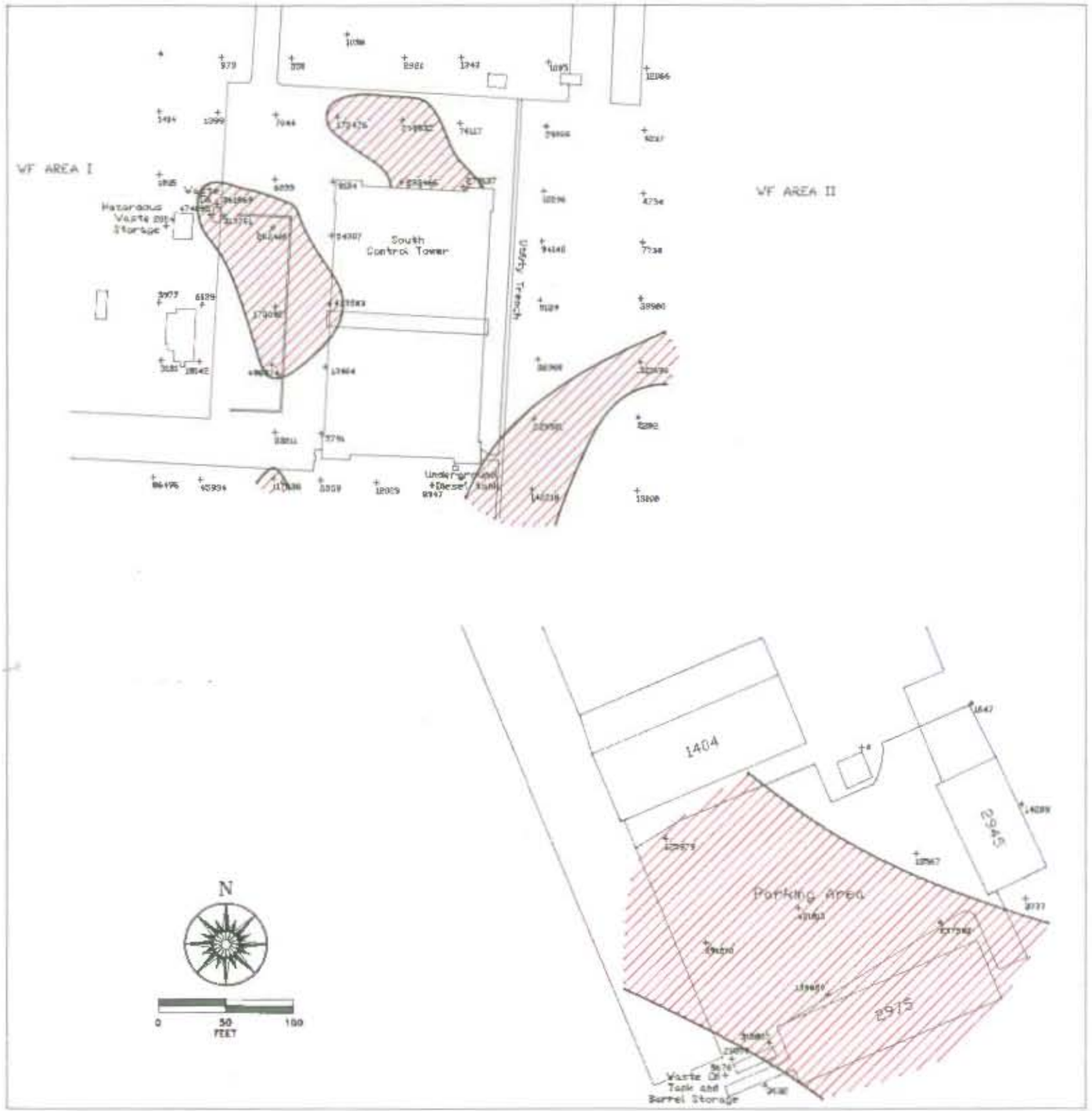
Trichloroethylene
(TCE)

NAS Whiting Field
South Field
Milton, Florida

Plate 2d

PETREX FINGERPRINT TECHNIQUE®

August 31, 1992



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LEGEND

Relative Response Values:

≥ 100,000

\+ Petrex Sample Location

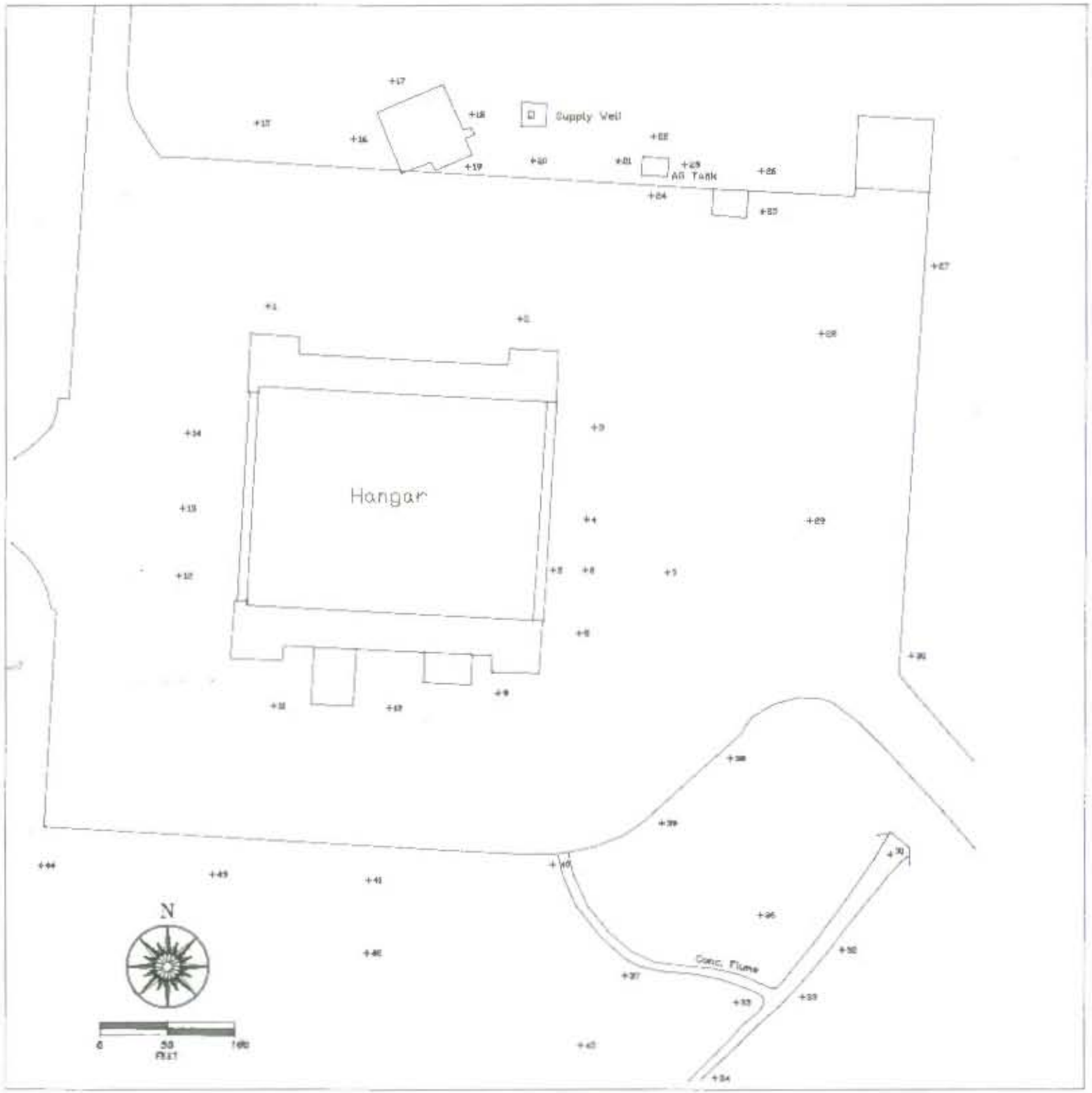
ABB Environmental Corp.

Relative Response
Cycloalkanes & Naphthalenes

NAS Whiting Field
South Field
Milton, Florida
Plate 2e

PETREX FINGERPRINT TECHNIQUE®

September 1, 1992



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LEGEND

+ Petrex Sample Location

ABB Environmental Corp.

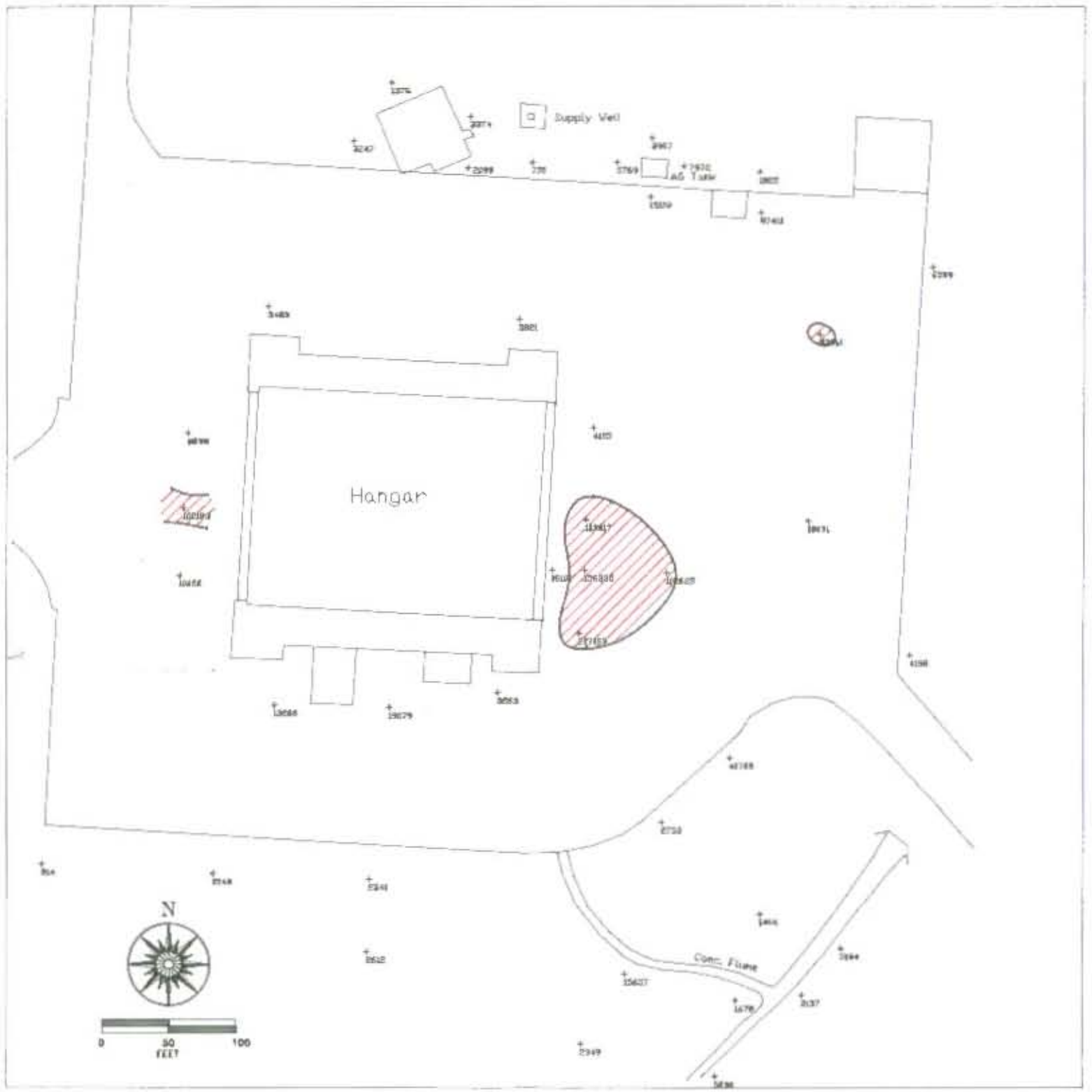
Sample Locations

NAS Whiting Field
Mid Field
Milton, Florida

Plate 3a

PETREX FINGERPRINT TECHNIQUE®

September 1, 1992



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LEGEND

Relative Response Values:

≥ 85,000

\+ Petrex Sample Location

ABB Environmental Corp.

Relative Response

Benzene, Toluene, Ethylbenzene & Xylenes (BTEX)

NAS Whiting Field

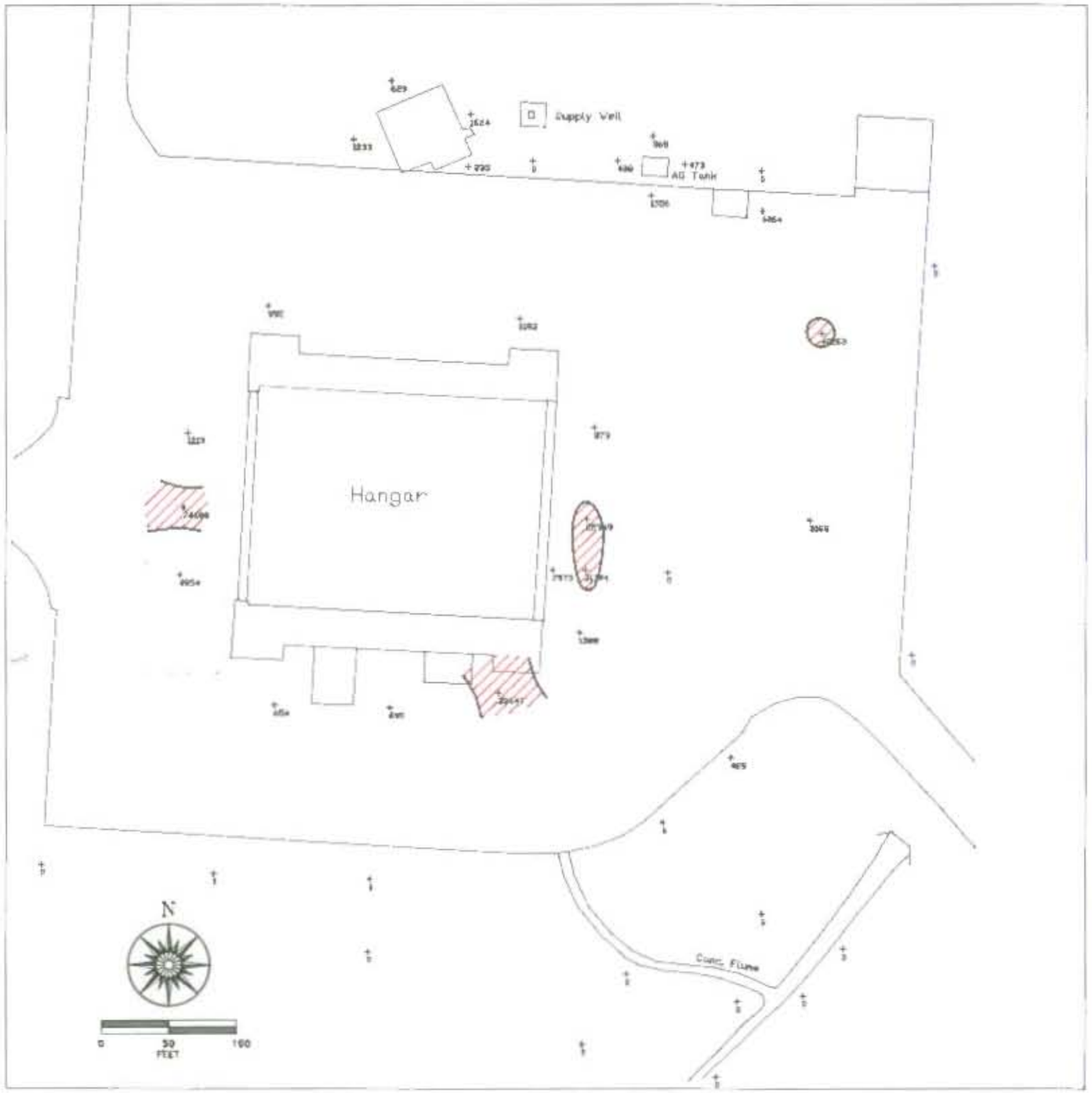
Mid Field

Milton, Florida

Plate 3b

PETREX FINGERPRINT TECHNIQUE®

September 1, 1992



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LEGEND

Relative Response Values:

≥ 10,000

\+ Petrex Sample Location

ABB Environmental Corp.

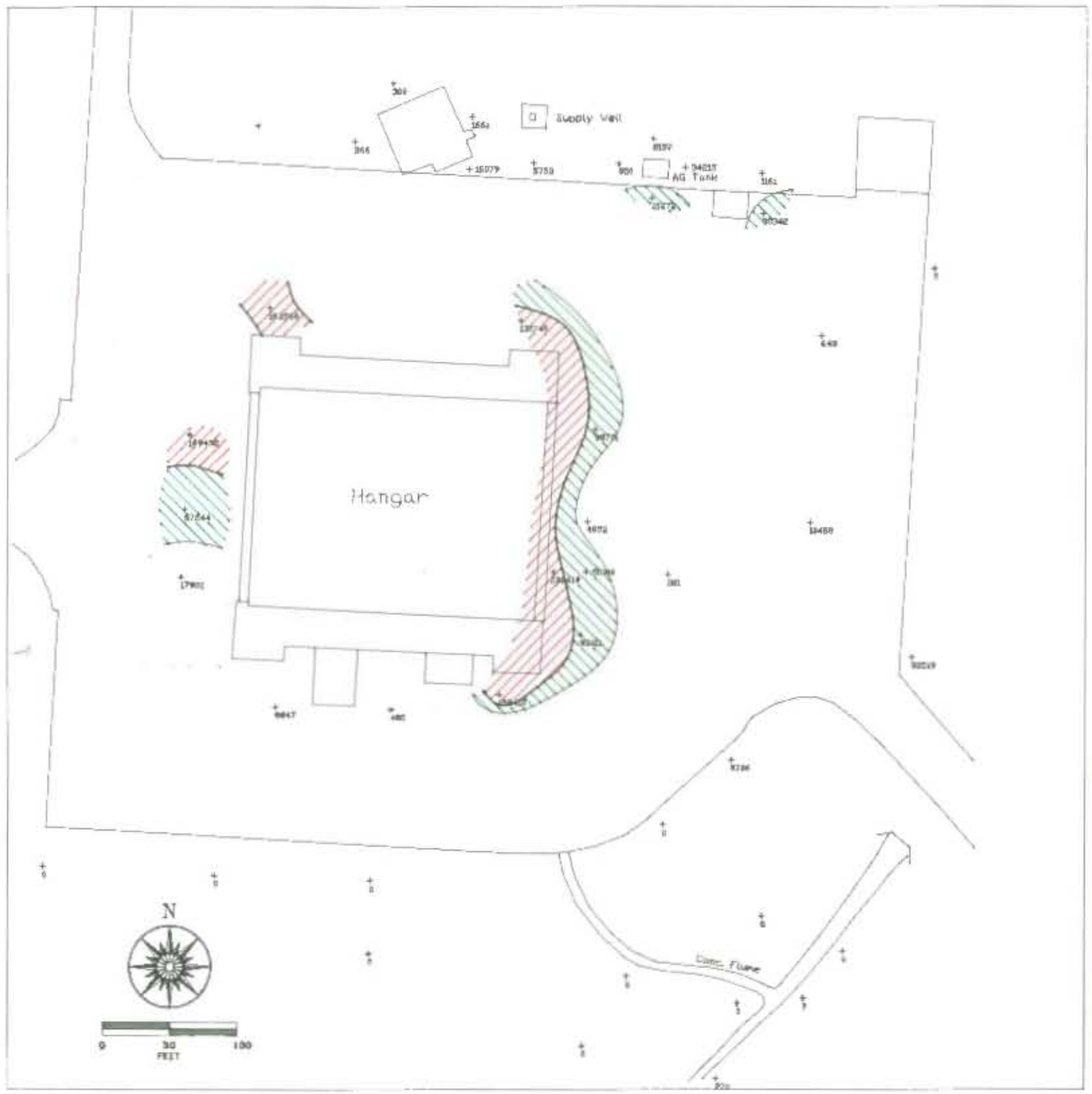
Relative Response
Tetrachloroethylene
(PCE)

NAS Whiting Field
Mid Field
Milton, Florida

Plate 3c

PETREX FINGERPRINT TECHNIQUE®

September 1, 1992



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LEGEND

Relative Response Values:

≥ 100,000

50,000–99,999

\+ Petrex Sample Location

ABB Environmental Corp.

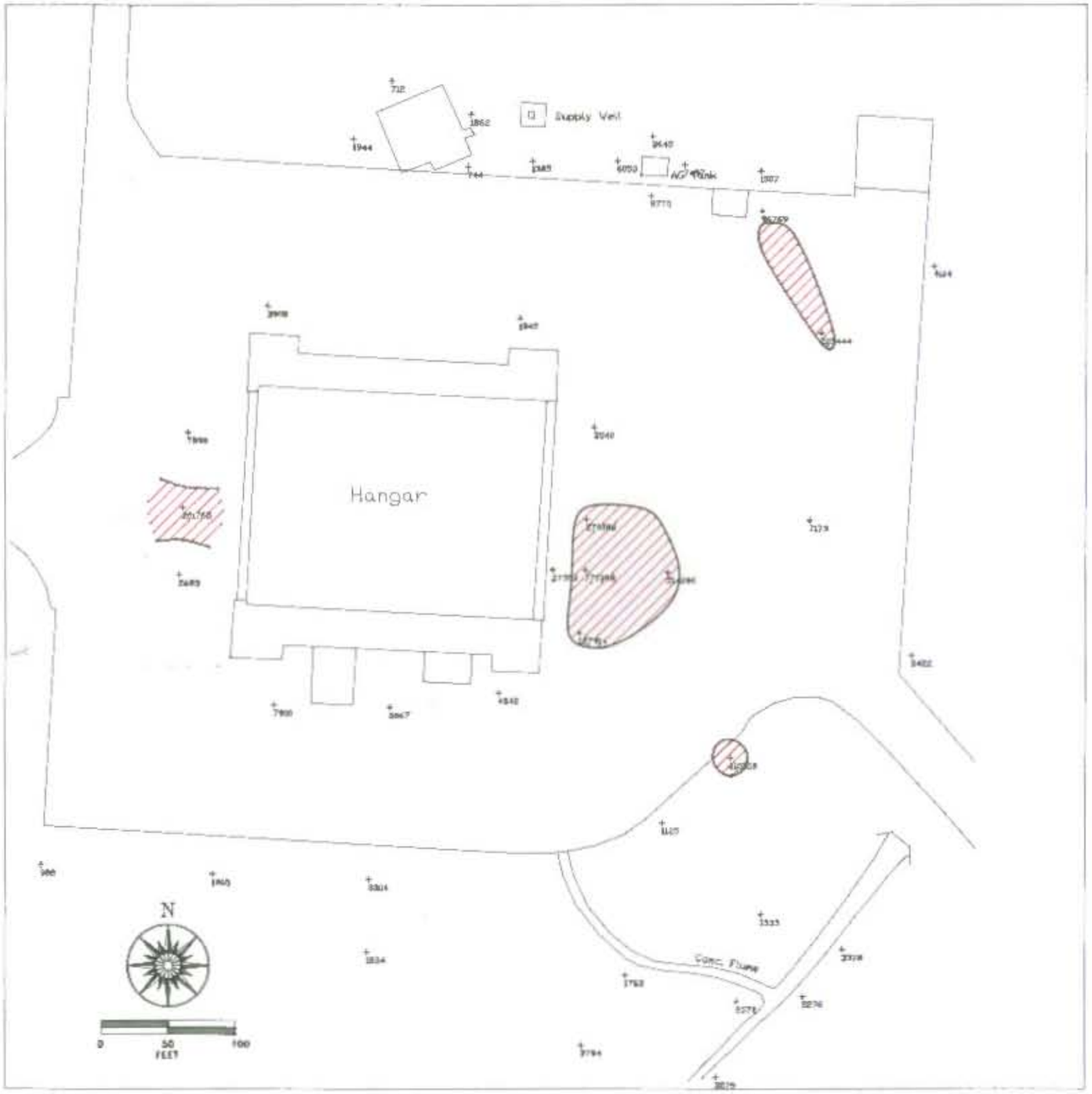
Relative Response
Trichloroethylene
(TCE)

NAS Whiting Field
Mid Field
Milton, Florida

Plate 3d

PETREX FINGERPRINT TECHNIQUE®

September 1, 1992



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LEGEND

Relative Response Values:

≥ 100,000

\+ Petrex Sample Location

ABB Environmental Corp.

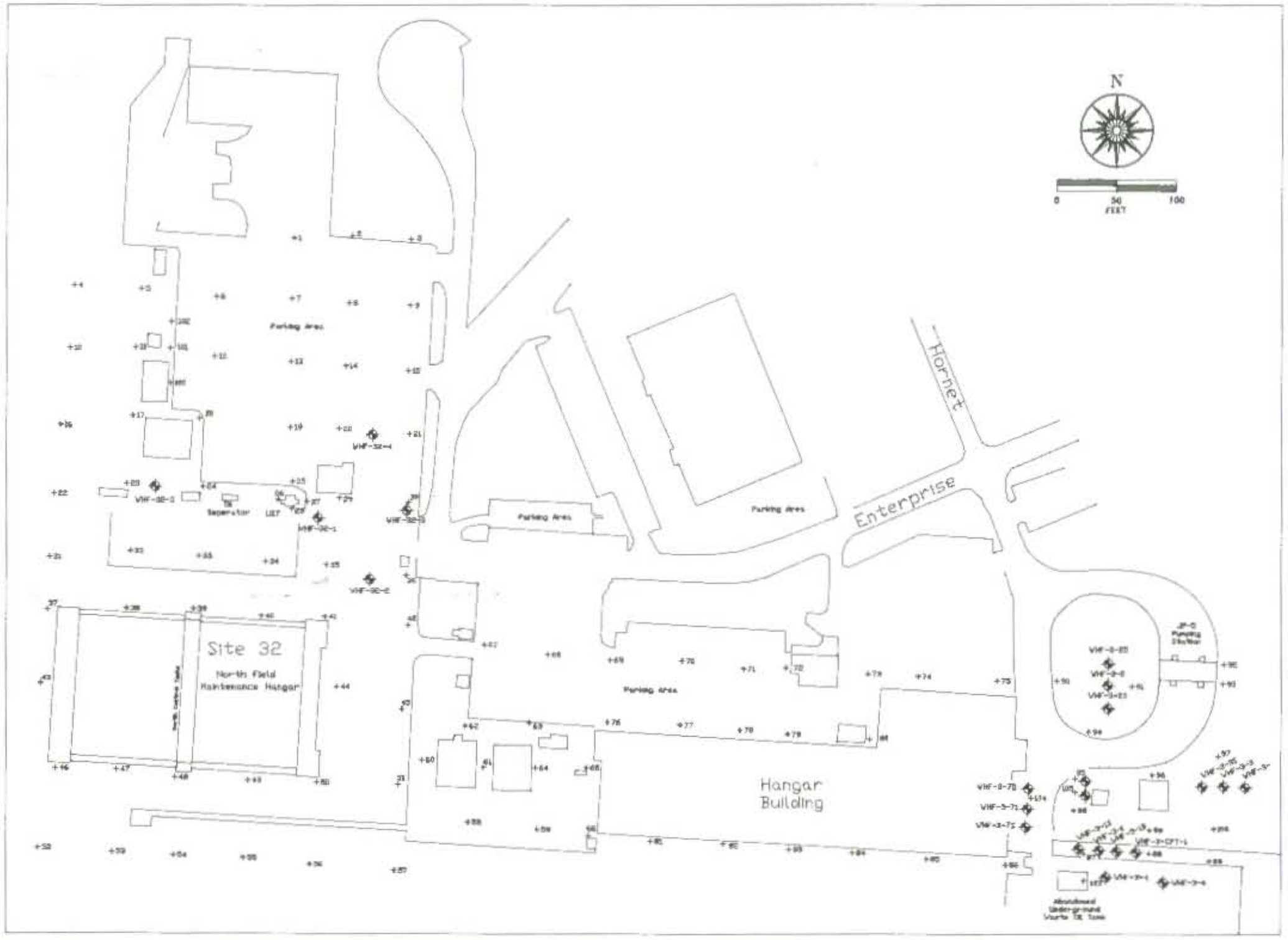
Relative Response
Cycloalkanes &
Naphthalenes

NAS Whiting Field
Mid Field
Milton, Florida

Plate 3e

PETREX FINGERPRINT TECHNIQUE®

September 1, 1992



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LEGEND

+ Petrex Sample Location

Monitoring Well Location

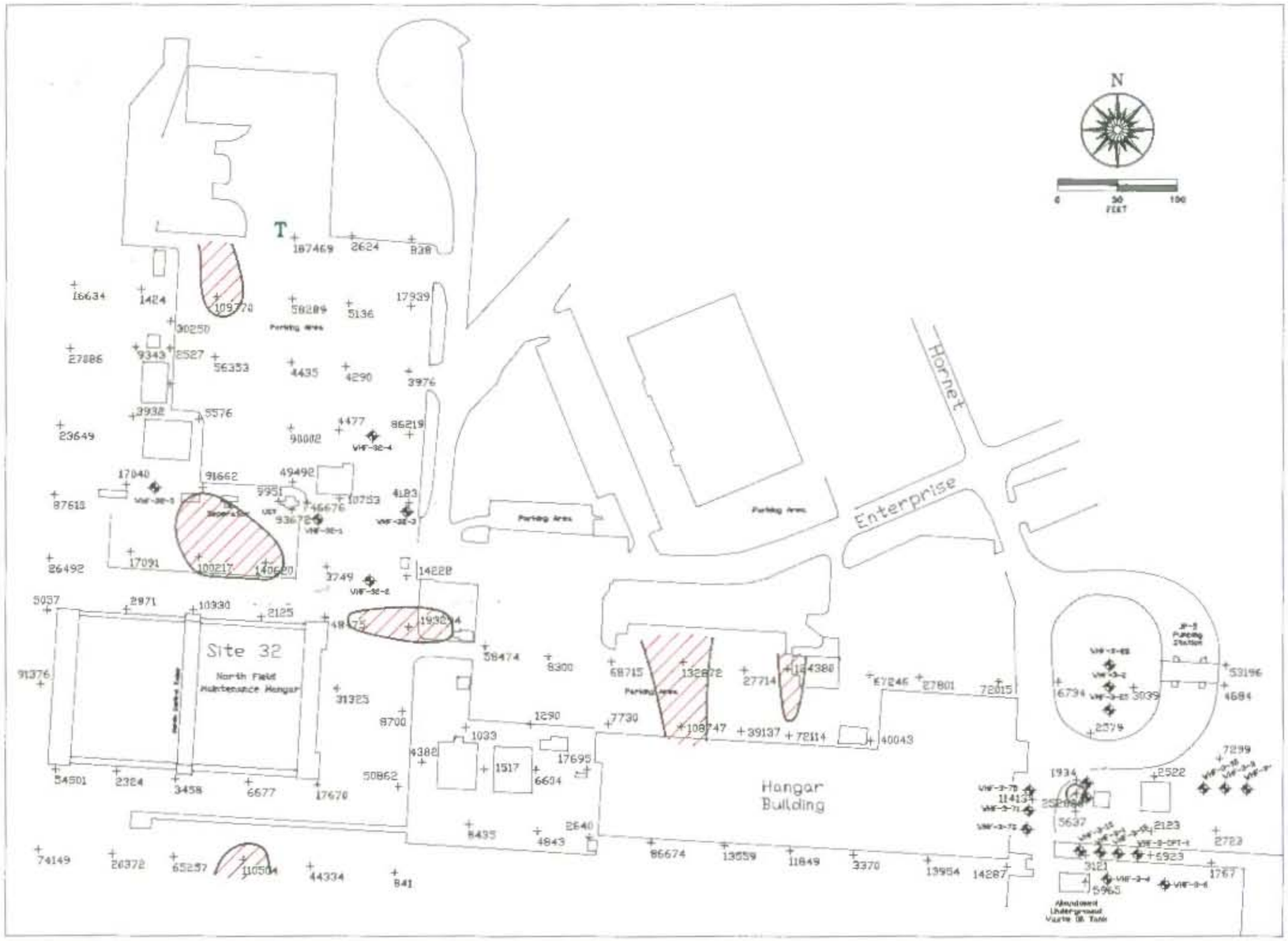
ABB Environmental Corp.

Sample Locations

NAS Whiting Field
North Field
Milton, Florida
Plate 1a

PETREX FINGERPRINT TECHNIQUE®

August 28, 1992



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LEGEND

Relative Response Values:

≥ 100,000

\+ Petrex Sample Location

Monitoring Well Location

T The response at this location was determined to be due primarily to naturally occuring aromatic terpene compounds.

ABB Environmental Corp.

Relative Response

Benzene, Toluene, Ethylbenzene, & Xylenes (BTEX)

NAS Whiting Field

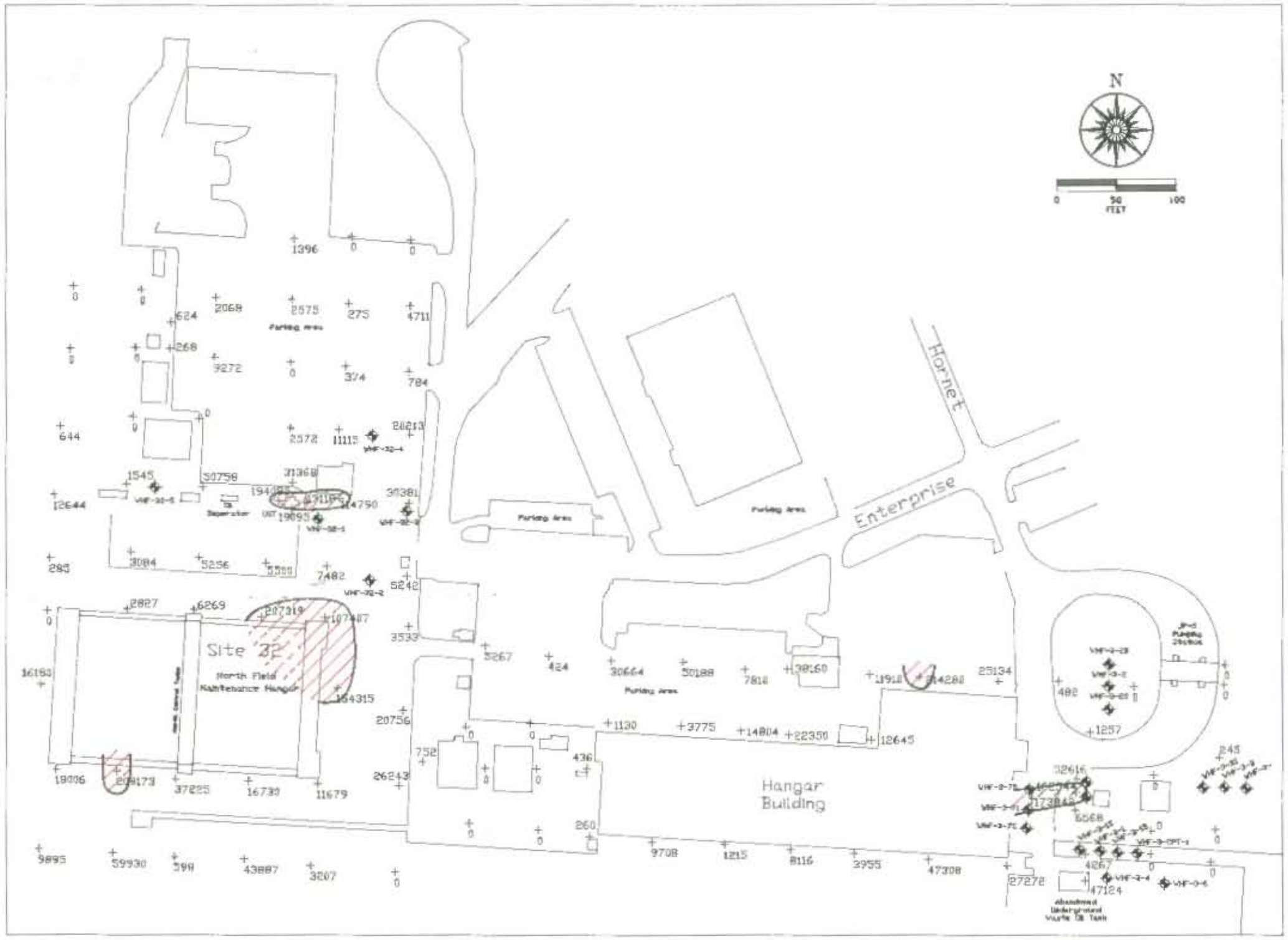
North Field

Milton, Florida

Plate 1b

PETREX FINGERPRINT TECHNIQUE®

August 27, 1992



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LEGEND

Relative Response Values:

≥ 100,000

+ Petrex Sample Location

Monitoring Well Location

ABB Environmental Corp.

Relative Response
Tetrachloroethylene
(PCE)

NAS Whiting Field
North Field
Milton, Florida

Plate 1c

PETREX FINGERPRINT TECHNIQUE®

August 31, 1992

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LEGEND

Relative Response Values:

≥ 100,000

+ Petrex Sample Location

Monitoring Well Location

ABB Environmental Corp.

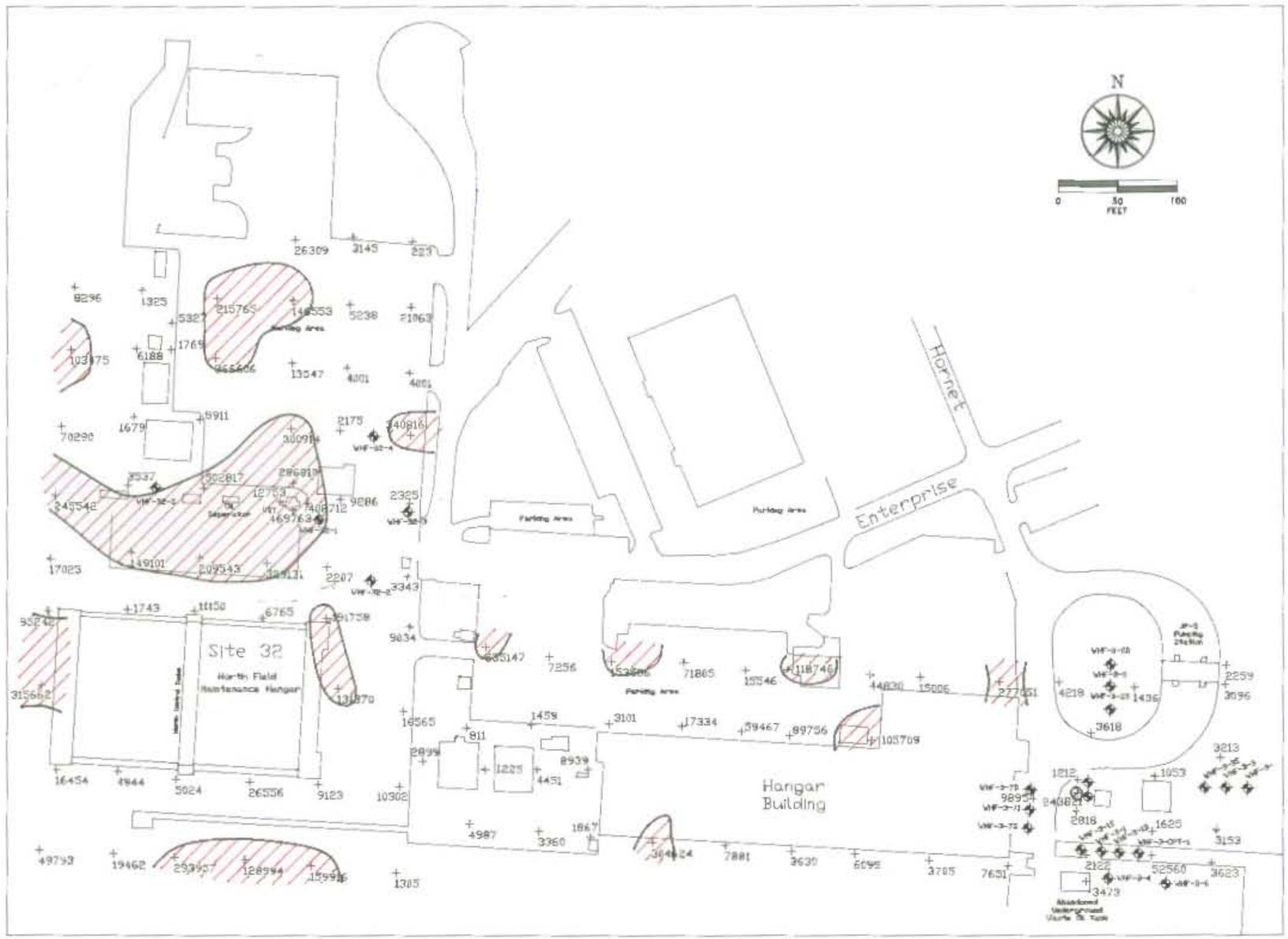
Relative Response

Trichloroethylene (TCE)

NAS Whiting Field
North Field
Milton, Florida
Plate 1d

PETREX FINGERPRINT TECHNIQUE®

August 31, 1992



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LEGEND

Relative Response Values:

≥ 100,000

+ Petrex Sample Location

Monitoring Well Location

ABB Environmental Corp.

Relative Response

Cycloalkanes & Naphthalenes

NAS Whiting Field
North Field
Milton, Florida
Plate 1e

PETREX FINGERPRINT TECHNIQUE

August 31, 1992